4. WOOD ANATOMY OF HUNGARIAN TERTIARY LIGNITES

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Abstract

Ten lignit samples of different localities and different preservation state were investigated with light microscope. Nine samples are of *gymnospermous* origin (*Taxodiaceae*), and only one *angiosperm (Betulaceae)* woody remnant was observed. Based on the results of the presented samples six were selected for partial dissolution experiment and for transmission electron microscopical investigations.

Key words: Xylotomy, LM anatomy, Tertiary, Hungary.

Introduction

The LM results presented in this contribution are within the combined research program of our Laboratory. The method and the first LM wood anatomical data were published previously (KEDVES, 1997). The first TEM results of this research program are presented in this volume (KEDVES and PÁRDUTZ, 1999).

The aim of this paper is:

1. to determine ten different samples based on the wood anatomical characteristic features.

2. to investigate the different kind of preservation of the fossil wood for the selection of partial dissolution and transmission electron microscopical investigations.

Materials and Methods

The samples of this part of the research program were collected by Dr. M. SZÓNOKY (Department of Geology and Paleontology of the J.A.University, Szeged, Hungary). Thin slides, and macerated lignit samples were investigated by light microscope. The localities and other documents of the material of investigation will be presented together with the most important anatomical descriptions.

Results

Sample no 3 (Plate 4.1., figs. 1-6)

Locality: Mohács, Upper Pannonian, brick-works, lower level.

Plate 4.1.

1-6. Sample no 3, *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967.
1. Cross section, 250x.
2. Tangential section, 250x.
3. Horizontal wall of the longitudinal parenchyma, 500x.
4. Radial section, bordered pits, 1.000x.
5,6. Radial sections, cross-field pits, 1.000x.
7-10. Sample no 11, *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967.
7. Cross section, 250x.
8. Tangential section. 250x.
9. Longitudinal parenchyma, illustrated are the horizontal wall and the resin drops, 1.000x.
10. Radial section, 1.000x.

Plate 4.2.

1-3. Sample no 10, *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967.
1. Cross section, 250x.
2. Tangential section, 1.000x.
3. Radial section, 1.000x.
4-7. Sample no 12, *Sequoioxylon medullare* (GÖPPERT) GREGUSS 1967.
4. Cross section, 250x.
5. Cross section, 1.000x.
6. Tangential section, 250x.
7. Radial section, 500x.

Plate 4.3.

1-4. Sample no 7, *Sequoioxylon medullare* (GÖPPERT) GREGUSS 1967.
1. Cross section. 500x.
2. Tangential section, 250x.
3. Tangential section, horizontal wall of the longitudinal parenchyma, 1.000x.
4. Radial section, 1.000x.
5,6. Sample no 4, *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1957.
5. Tangential section, 500x.
6. Radial section, 1.000x.

Plate 4.4.

1,2. Sample no 5, *Sequoioxylon medullare* (GÖPPERT) GREGUSS 1967.
1. Tangential section, horizontal wall of the longitudinal parenchyma, 1.000x.
2. Radial section pitting of the cross fields, 1.000x.
3,4. Sample no 9, *Sequoioxylon medullare* (GÖPPERT) GREGUSS 1967, radial sections, 1.000x.

Plate 4.5.

1,2. Sample no 6, *Sequoioxylon medullare* (GÖPPERT) GREGUSS 1967, radial sections, 1.000x.
3-5. Sample no 8, *Alnus*
3,5. Scalariform perforations of vessel, 1.000x.
4. Multiseriate pitting of vessel, 1.000x.

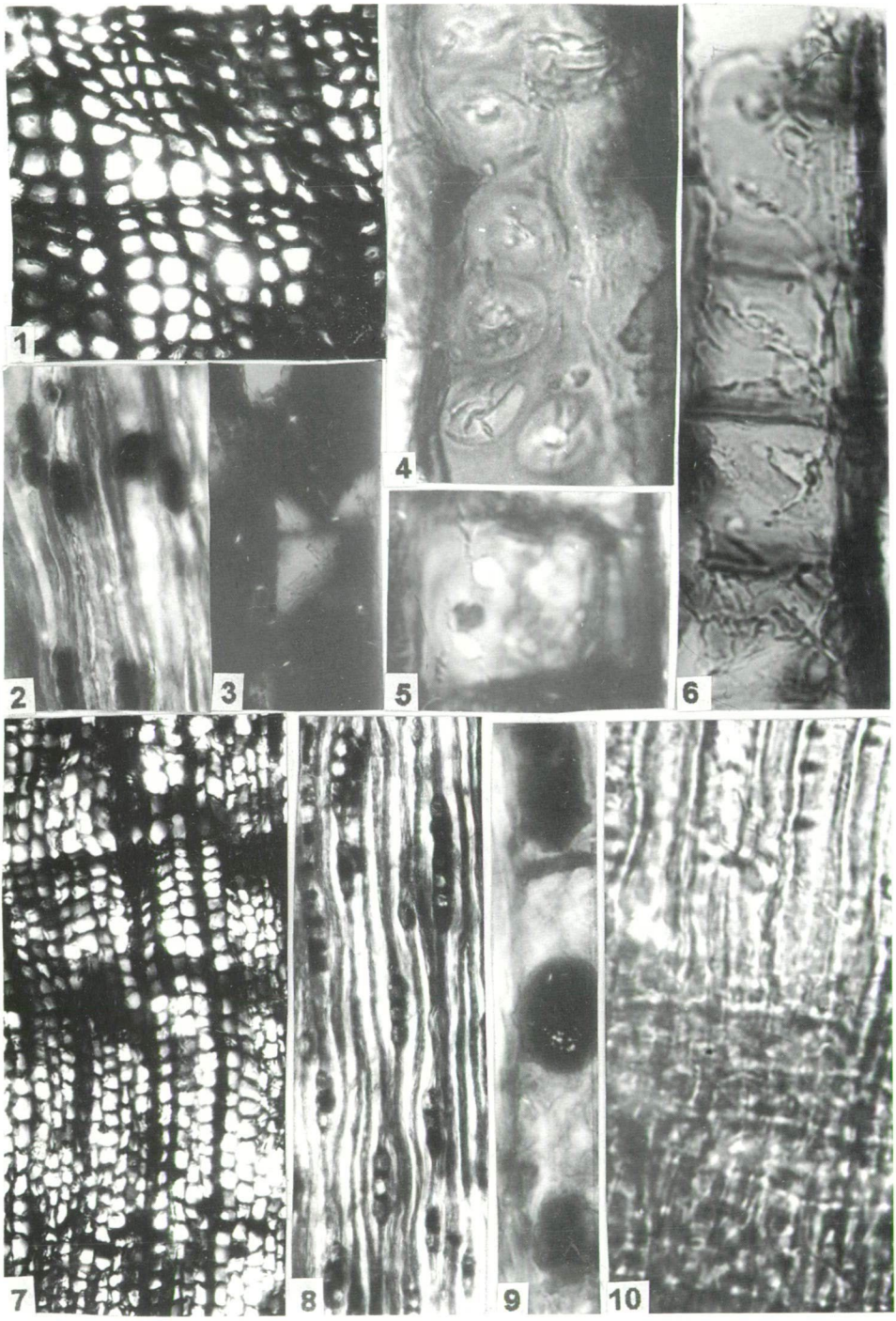


Plate 4.1.

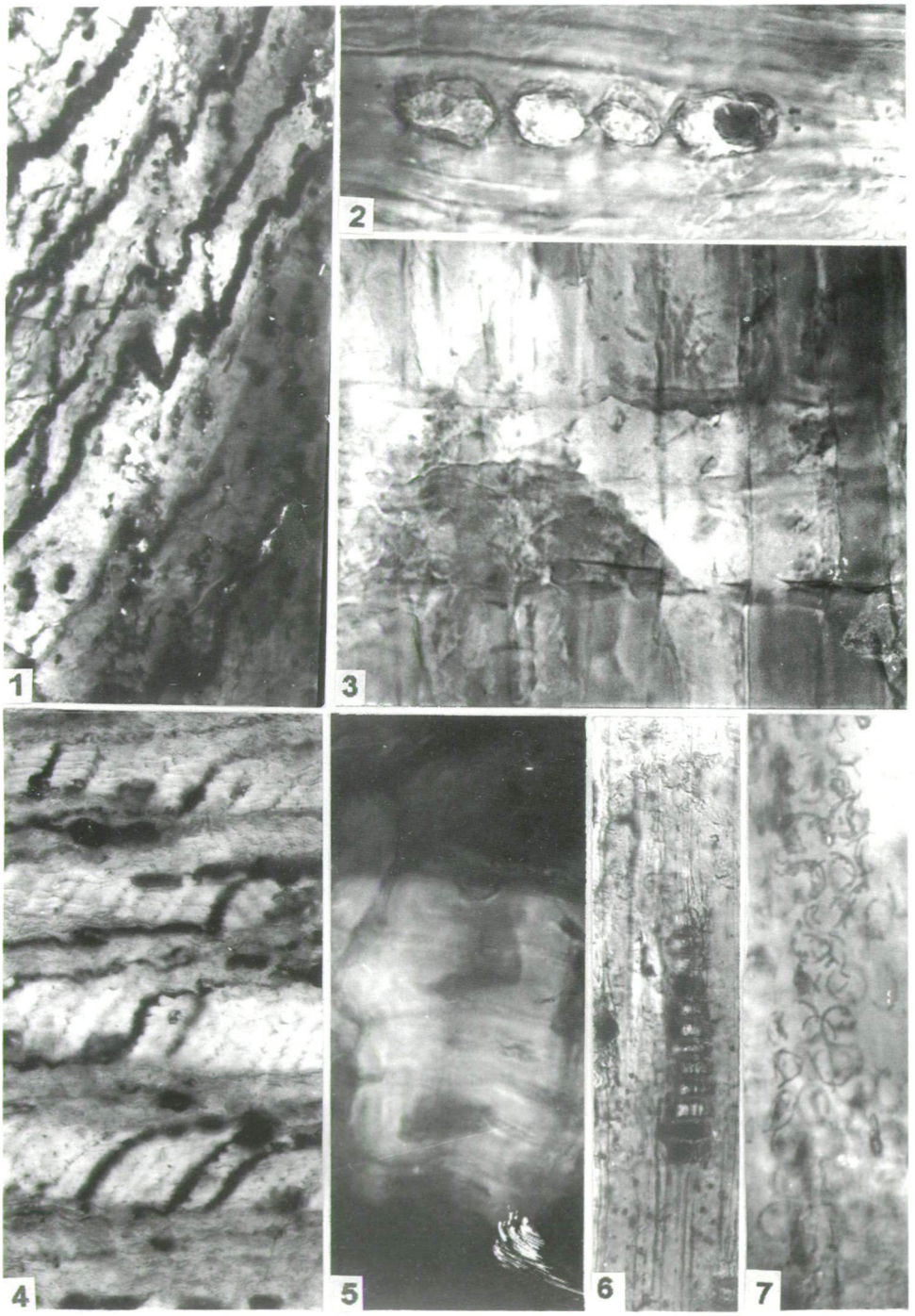


Plate 4.2.

Plate 4.3.

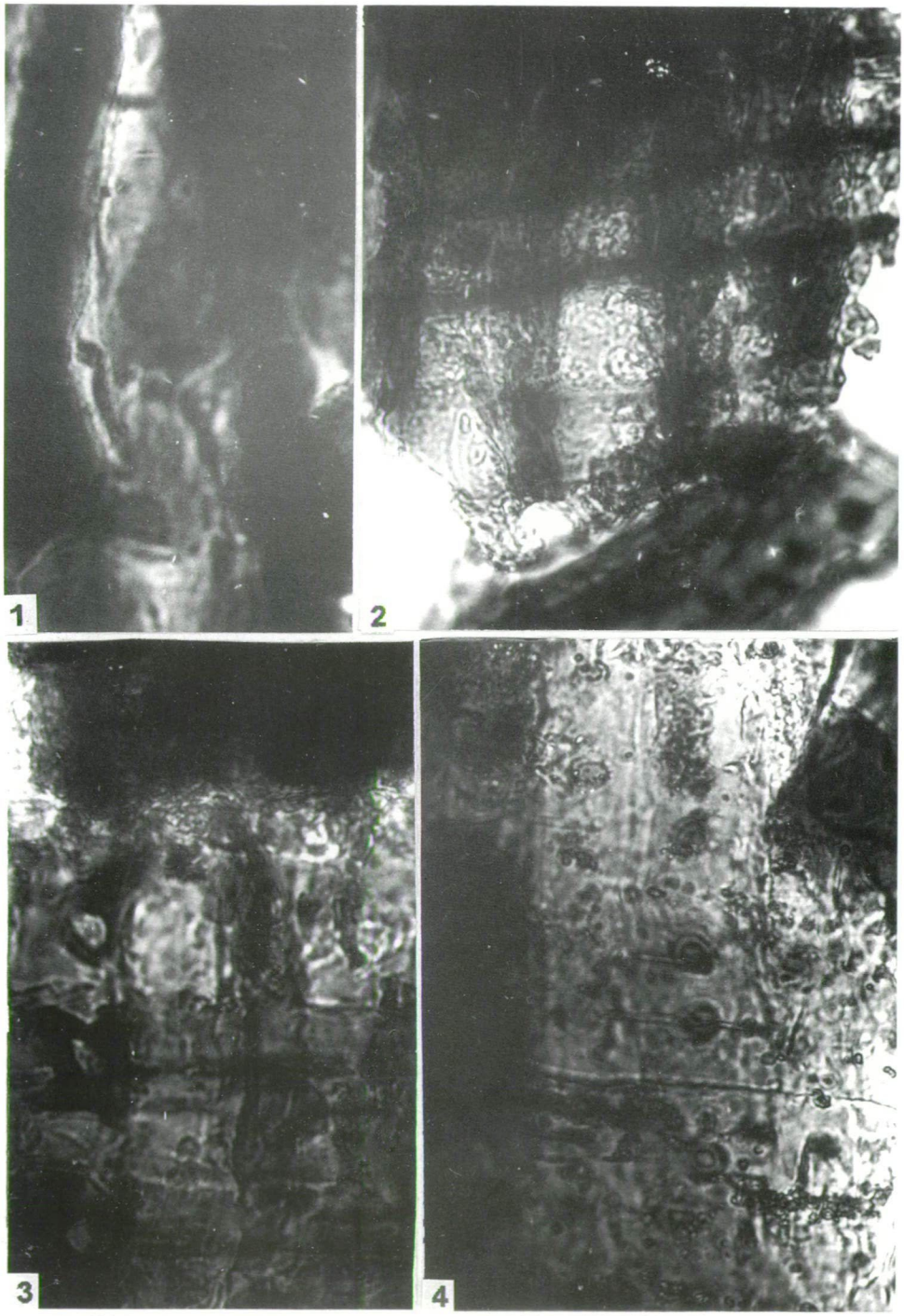


Plate 4.4.

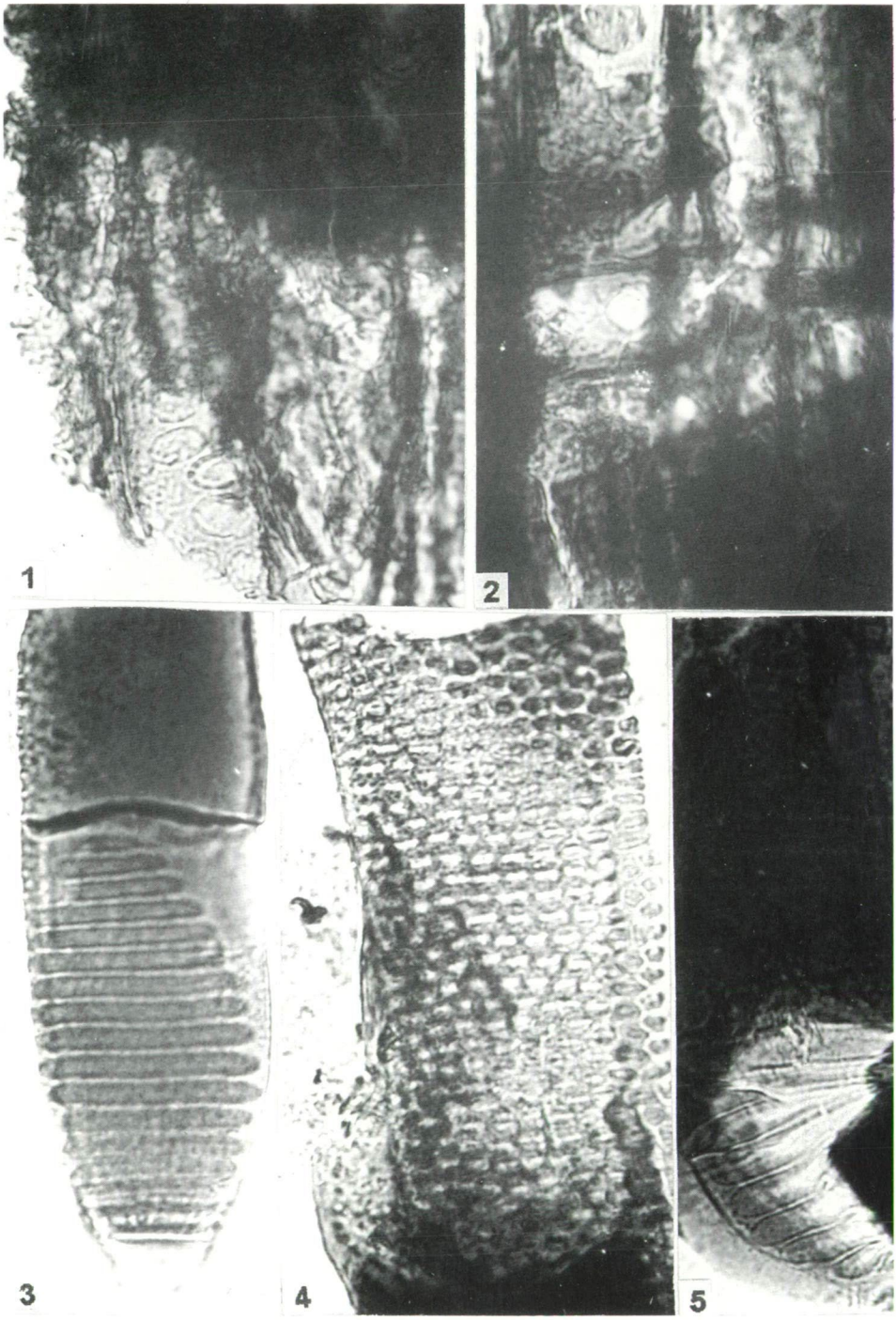


Plate 4.5.

LM anatomy. - The secondary wood is carbonified. The annual rings are narrow about 2-5 tracheids wide (Plate 4.1., fig. l). The rays are uniseriate and 1-6 cells high, 49 per cent of the rays are 2 cells high. The quantitative data are summarized in text-fig. 4.2. The ray cells are full of reddish-brown resin content (Plate 4.1., fig. 2). The horizontal walls of the parenchyma are smooth (Plate 4.1., fig. 3). The bordered pits are arranged in one or in two rows (Plate 4.1., fig. 4). In one cross fields there are 2-4 taxodioid pits (Plate 4.1., figs. 5,6).

Sample no 11 (Plate 4.1., figs. 7-10)

Locality: Bátaszék, Upper Pannonian, layer D-1/L.

LM anatomy. - Similar to the previous one. The ray cells are not completely full of resin content (Plate 4.1., fig. 8). The quantitative data of the per cents of cells of different height are summarized in text-fig. 4.2. The horizontal walls of the parenchyma are smooth (Plate 4.1., fig. 9). The resin content of the longitudinal parenchyma cells is in drops. The pits of the radial wall of the tracheids are similar to the previous samples.

Sample no 10 (Plate 4.2., figs.1-3)

Locality: Bátaszék, Upper Pannonian, layer D-1/B.

LM anatomy. - The structure of the secondary wood is altered during the fossilization and compressed. In general the late wood is in more or less is well preserved. The annual ring was definite, in the late wood there are about 4-6-10 seriate thick walled tracheids with narrow lumina (Plate 4.2., fig. 1). The ray cells are uniseriate and 1-11 cells high, 42.5 per cent of the rays are 2 cells high, quantitative data are in text-fig. 4.2. The horizontal walls of the parenchyma are smooth, the resin content in drops. The bordered pits of the late wood are arranged in one row. In the cross fields there are generally two taxodioid pits (Plate 4.2., fig. 3).

Sample no 12 (Plate 4.2., figs. 4-7)

Locality: Bátaszék, western profile, Upper Pannonian.

LM anatomy. - The structure of the secondary wood is damaged and compressed during the fossilization process (Plate 4.2., figs. 4,5). The tracheids of the late wood are 6-8-10 seriate. Sometimes there are light walled fields in the late wood (Plate 4.2., fig. 5). The ray cells are uniseriate and 1-15 cells high. The quantitative data are completely different in contrast to the previous samples (Text-fig. 4.2.). The 4-7 cells high rays are in the highest quantity (15.3, 15.0, 14.0%). There are resin drops in the parenchyma, the horizontal walls are smooth. The pits of the radial wall of the tracheids are biseriate (Plate 4.2., fig. 7). In the cross fields there are in general two taxodioid pits.

Sample no: 7 (Plate 4.3., figs. 1-4)

Locality: Bátaszék, well no 7, depth 168.0 m., Upper Pannonian.

LM anatomy. - The structure of the secondary wood is carbonified and damaged. (Plate 4.3., fig. 1). The late wood of the annual rings is 3-6 tracheids wide. The ray cells are uniseriate and 1-16 cells high (Plate 4.3., figs. 2,3). The quantitative data are illustrated in text-fig. 4.2. Rays of 2 cells high are in the greatest quantity (35.0%). The horizontal walls of the parenchyma are smooth, (Plate 4.3., fig. 3) there are resin drops in it (Plate 4.3., fig. 2). The pits of the radial wall of the tracheids are not so well discernible, but uniseriate. In the cross fields there are about two probably taxodioid pits (Plate 4.3., fig. 4).

Sample no: 4 (Plate 4.3., figs. 5,6)

Locality: Keresztespuszta, well no 1, depth 230.7 m., Upper Pannonian.

LM anatomy. - The structure of the secondary wood is compressed and disorganized. In general taxonomically important anatomical characteristic features were observed at the late wood. The ray cells are uniseriate and 1-16 cells high (Plate 4.3., fig. 5), text-fig. 4.2. The horizontal walls of the parenchyma are smooth, and there are great resin drops in these cells. The pits of the radial wall of the tracheids are arranged in two rows. In the cross fields there are 4-5 taxodioid or cupressoid pits (Plate 4.3., fig. 6).

Sample no: 5 (Plate 4.4., figs. 1,2)

Locality: Abaliget, well no 5, depth 297.8-211.7 m., 2nd coal layer., Upper Pannonian.

LM anatomy. - The structure of the lignit sample is disorganized, invesigations were made only by macerated fragments. The horizontal walls of the parenchyma are smooth (Plate 4.4., fig. 1). The bordered pits of the radial wall of the tracheids are generally arranged in one or two rows. There are 2-4 taxodioid pits in the cross fields (Plate 4.4., fig. 2).

Sample no: 9 (Plate 4.4., figs. 3,4)

Locality: Bátaszék, layer Ny-3, "big tree-trunk", Upper Pannonian.

LM anatomy. - Similarly to the previously discussed sample the anatomical characteristic features were discernible at the late wood. The number of the ray cells is relatively high. The pits of the radial wall of the tracheids are generally uniseriate. In the cross fields there are 2-4 pits of taxodioid or cupressoid character. (Plate 4.4., fig. 4).

Sample no: 6 (Plate 4.5., figs. 1,2)

Locality: Bátaszék., well no 3, depth 220.0 m., Upper Pannonian.

LM anatomy. - Based on the observation of macerated fragments this lignit sample is also of *Taxodiaceae* (probably *Sequoia*) origin. The horizontal walls of the parenchyma are smooth. The number of the ray cells is relatively high. The bordered pits of the radial wall of the tracheids are arranged in two rows (Plate 5.5., fig. 1). In the cross fields there are 2 taxodioid pits (Plate 5.5., fig. 2).

Sample no: 8 (Plate 5.5., figs. 3-5)

Locality: Bátaszék, well no 37, depth 92 m., Upper Pannonian.

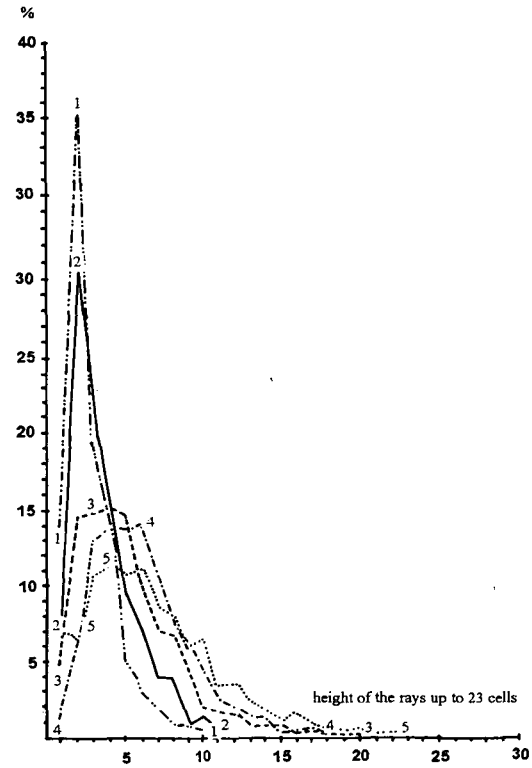
LM anatomy. - The sample was very small, it was impossible to prepare thin slides from it. Based on the study of the macerated fragments *angiosperm* wood may be determined. Characteristic scalariform perforations of vessel (Plate 4.5., figs. 3,5) and characteristic pitting (Plate 4.5., fig. 4).

Discussion and Conclusions

1. Botanical affinities of the investigated samples.

1.1. *Gymnosperm* woods. Nine samples are in all probability of *Taxodiaceae* origin. The more or less well preserved samples may be compared with the recent *Sequoia* genus. For the determinations of the *gymnosperm* woods we used as one of the anatomical characteristic features the graphs of the per cents of height of the rays. This method was used for the characterization of the Hungarian lignites by MAÁCZ (1955a), and HARASZTY (1957,1958a). In another paper, HARASZTY (1958b) applied this method for lignit samples of Romania. To this it is necessary to emphasize the statements of

MAÁCZ (1955b) on the secondary wood of the recent *Metasequoia glyptostroboides*. Important differences were established in this point of view between the anatomy of the trunk and the branch. The text-figure of the writer (KEDVES, 1959) with the previous data are republished herein (Text-fig. 4.1). In this paper two types were distinguished such as: *Sequoioxylon* cf. *gigantea* and *Sequoioxylon* cf. *sempervirens*, in comparison to *Sequoia gigantea*, and *Sequoia sempervirens*. Regarding the results of our recent investigations we can establish the following (Text-fig. 4.2.):



Text-fig. 4.1.

Graphs of the percentages of the height of the rays of recent and fossil *Sequoia* taxa. This figure was published first in the paper of KEDVES (1959), the redrawn form is presented herein for comparison.

1. *Sequoioxylon* cf. *gigantea*, fossil.
2. *Sequoia gigantea* , recent.
3,4. *Sequoioxylon* cf. *sempervirens*, fossil.
5. *Sequoia sempervirens*, recent.

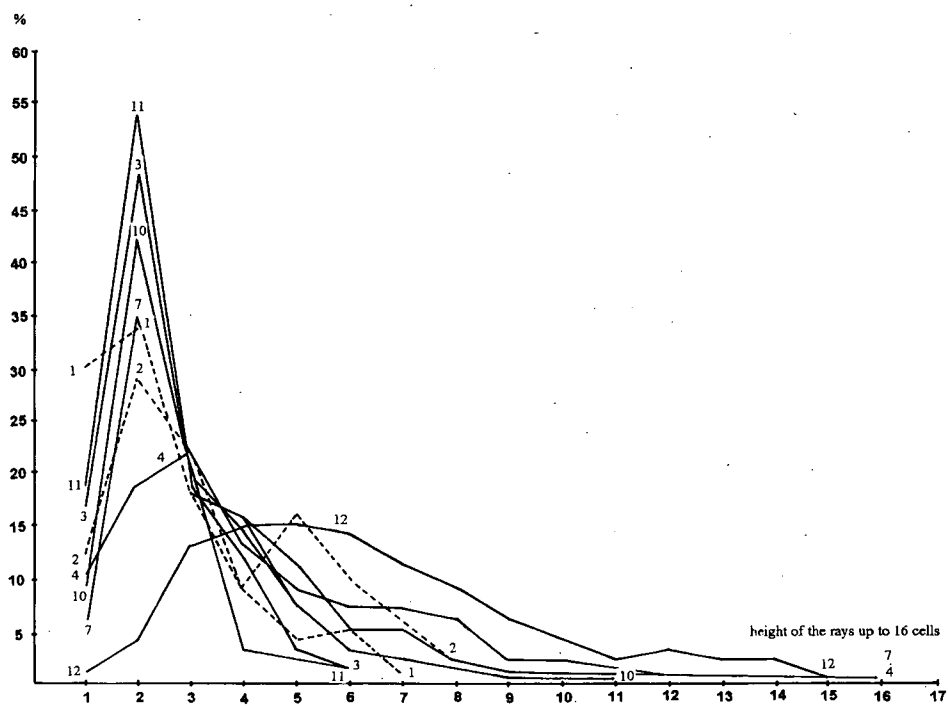
Two types may be distinguished: The first one is more or less identical or similar to the "*Sequoioxylon* cf. *gigantea*" type. Samples no 1, 7, 10, 3 and 11 may be classed into this group. Sample no 2 in this point of view represents an intermediate type between the *S. gigantea* and *S. sempervirens* group. Finally samples no 4 and 12 are similar to the *S. sempervirens* type. Sample no 1 was determined previously as *Sequoioxylon gypsaceum* (GÖPPER) GREGUSS 1967, and sample no 2 as *S. medullare* GREGUSS 1967.

Taking into consideration further anatomical characteristics, particularly the pits in the cross fields the investigated *gymnospermous* samples were determined as follows:

Sequoioxylon gypsaceum (GÖPPERT) GREGUSS 1967, samples: l, 3, 10, 11, 4.

Sequoioxylon medullare GREGUSS 1967, samples: 2, 12, 7, 5, 9, 6.

Based on our present day knowledge we can point out that sample no 4 is interesting in wood anatomical point of view. But on the other hand we must take into consideration that the preservation of this sample is not so good.



Text-fig. 4.2.

Graphs of the percentages of the height of the rays of the samples investigated within this program. The anatomical description of the samples no 1 and 2 was published previously (KEDVES, 1997).

As regards the nomenclature of the fossil *Sequoia* wood remains there are different concepts. Some selected one are as follows: GRABOWSKA (1956) described very well preserved wood remnant as *Taxodioxylon gypsaceum* (GÖPPERT) KRÄUSEL, and enumerated several previous bibliographical data. The number of the pits in the cross-fields is generally 2. HARASZTY (1958) following the terminology of GOTHAN for the fossil woods which are of the *Sequoia sempervirens* type, the species name *Taxodioxylon sequoianum* (syn.: *T. gypsaceum* KRÄUSEL) was used. But later (HARASZTY, 1960) described further fossil woods of this type as *Taxodioxylon gypsaceum*.

Following HUARD (1965), *Taxodioxylon gypsaceum* (GÖPPERT) KRÄUSEL: *Sequoia sempervirens* ENDL., and *Taxodioxylon giganteoides* HUARD: *Sequoiadendron giganteum* (DECAISNE) BUCHHOLZ.

In the paper of PÁLFALVY and RÁKOSI (1979) *Sequoioxylon gypsaceum* (GÖPPERT 1842) GREGUSS 1967 name was used.

From the LM anatomically investigated samples the following samples were selected for further TEM studies: 3, 10, 7, 11, 12, 4.

1.2. *Angiosperm* wood.

In general angiosperm wood remnants are not so common in lignites. To this the paper of HUARD (1966/67) is worth of mentioning. In this paper *Quercoxylon pauciporosum* nov. sp. was described from the Neogene lignite of Arjuzanx (Landes), France. In this paper another *angiosperm* remnant, *Laurinoxylon* FÉLIX was also mentioned. The determination of the fossil *Lauraceae* was published in another paper (HUARD, 1967).

Based on our limited data the botanical affinity of our sample no: 8, the genus *Alnus* is probable (cf. GREGUSS, 1945, 1969).

Acknowledgements

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